Piezoelectric Turbomachinery for High Power Density Actuation

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Objective and Scope

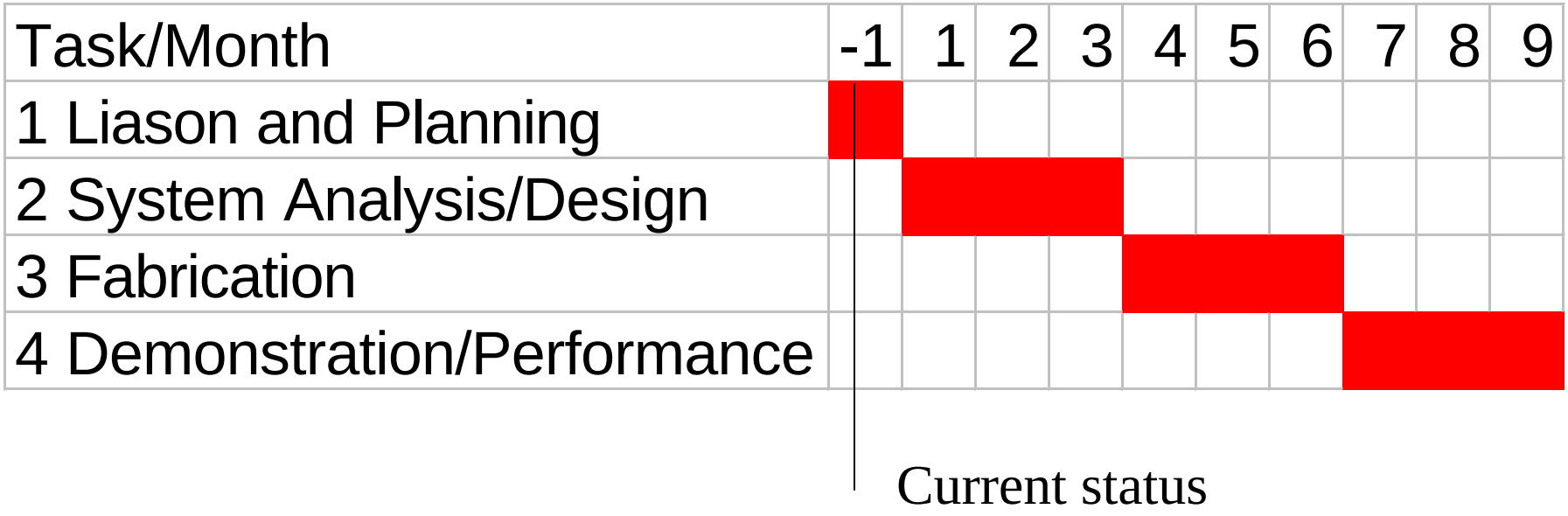
Objective

- Demonstrate using piezoelectric actuators to pump fluid at high pressures and flow rates

Scope

- Develop model of piezoelectrically-driven fluid to predict pressure and flow rate
- Design piezoelectrically-actuated pump
- Fabricate proof-of-concept bench-top demonstration
- Verify models and predict performance range and limits

Project Timeline



Contractors and Subcontractors

- Contractor - Concepts Northern Research, Inc.
  - Objectives
    - Model fluid-structure interaction and design piezoelectric pump
    - Fabricate bench-top demonstration, integrate power electronics, timing, and controller
    - Test article, verify model, predict performance limits
  - Current Status: waiting for contract

Contractors and Subcontractors (II)

- Subcontractor: Virginia Tech's Center for Integrated Mechanical Systems & Structures
  - Principal Investigator: Prof. Don Leo
  - Objectives:
    - Choose number of amplifier channels, select amplifiers, design timing controller
    - Deliver timing controller to Concepts
  - Current Status: waiting for subcontract

Major Accomplishments

- None currently
- Expected: demonstration of a unique breakthrough piezoelectrically activated pump

Program Gains

- None currently
- Expected: Demonstrated of pump with increased efficiency
  - due to no bearings needed
  - 10% efficiency losses due to bearings is standard
- Expected: Demonstration of a zero leakage pump
  - Due to no seals needed
  - Leakage is a problem in several applications where toxics are pumped

Transitions to Other Programs

- Active Control of Pump Impellor to Reduce Off-Design Performance Penalties (IRAD)
- Small High-Speed Pump Design and Analysis (IRAD)

Customers and Applications

- Piezoelectric pumps for portable and fixed electronic cooling applications
  - Reduced package size and reduced power requirements due to higher pump speeds
- Improved pump efficiencies for customers with high electricity costs
- Down-hole pump design for oil-recovery